

## SED fitting for Algol binaries with some observations taken during the eclipses. Postprint

**Authors:** Kovalev Mikhail

**Date:** 2026-04-01T09:37:07+00:00

### Abstract

I present a study of two Algol type systems, which have anomalous Spectral Energy Distribution (SED) fitting. It appears that these anomaly is simply caused by several observations taken during the eclipse, when only the cool component of the binary was visible. I take this into account and provide good fits using all available observations.

### Full Text

#### Preamble

Draft version April 1, 2026 Typeset using LATEX modern style in AASTeX631

SED fitting for Algol binaries with some observations taken during the eclipses.

Mikhail Yu. Kovalev ( )

Yunnan Observatories, China Academy of Sciences, Kunming 650216, China  
Key Laboratory for the Structure and Evolution of Celestial Objects, Chinese Academy of Sciences, Kunming 650011, China

### ABSTRACT

I present a study of two Algol type systems, which have anomalous Spectral Energy Distribution (SED) fitting. It appears that these anomaly is simply caused by several observations taken during the eclipse, when only the cool component of the binary was visible. I take this into account and provide good fits using all available observations.

## 1. INTRODUCTION

Recently Zhuang et al. (2025) analyzed sample of 23 Algol-type eclipsing binaries with accretion disks. They used a joint fit of the SED, a low resolution spectrum

from LAMOST (Zhao et al. 2012) and the light curve to get binary parameters.

However for one star J074133.84+135142.02 (J07 hereafter) they reported an anomaly in archival photometry from Two-Micron All-Sky Survey (2MASS Skrutskie et al. (2006)), so they excluded these data from the analysis. I explored their SED fit and confirm that combined flux is larger than observed 2MASS photometry, however these datapoints show good match with contribution from cool component only. I checked SED plots for remaining systems and found similar problem for another star J042332.57+444118.66 (J04 hereafter), although Zhuang et al. (2025) didn't mention it in text. In this Note I explain this anomaly by the eclipses and derive parameters from SED for J04 and J07 using all available datapoints, including 2MASS.

## 2. METHODS AND RESULTS

At first I found times for 2MASS observations on VizieR database (<http://vizier.cds.unistra.fr/>): J04 and J07 were observed on JD = 2451125.8191, 2450751.9726 d, respectively. Then I get linear ephemeris for these two systems from ASAS-SN catalog of variable stars (Jayasinghe et al. 2018; Christy et al. 2023):  $t_{\min} = 2457698.86715 + 7.0414E$  for J04 and  $t_{\min} = 2457098.86591 + 6.6457E$  for J07, with E - epoch. The [mikhail.kovalev@ynao.ac.cn](mailto:mikhail.kovalev@ynao.ac.cn)

period for J04 is double that given by Zhuang et al. (2025), which is  $P=3.5207$  d. The value of Zhuang et al. (2025) was therefore used. Then I computed phases for 2MASS observations:  $\phi = 0.028, 0.962$  for J04 and J07 respectively, which is within primary eclipses  $|\phi| \leq 0.05$ . Indeed, if infrared photometry was taken during eclipse, relative contribution of cool component to SED will be significantly larger, than smaller flux from hot component, while total flux will be smaller. This is what one can clearly see in the plots from Zhuang et al. (2025).

I use SEDfit code (Kounkel, M. 2023), modified to taking into account eclipses, to fit SED for J04 and J07 stars. Since contribution of hot component is smaller in 2MASS filters even without eclipse, so I set it to zero during the fit. Thus J, H, Ks are fitted only by cool component. Additionally I downloaded archival photometry from VizieR (Johnson B, V, Cousins U, B, V, R, I, GALEX N U V, Gaia DR3 G, BP, RP, WISE W 1, W 2, W 3, W 4) plus flux measurement in CaH, K filter from Pristine DR1 (Martin et al. 2024). All these data were fitted by combined flux of two components.

W 4 measurement is reported as higher limit, so it wasn't used during the fit. SEDfit allows fitting of Gaia XP low resolution spectrum, however I don't fit it, but use it for verification of the fit for J07. I use spectral models from BT-Settl (Allard et al. 2011). Parallax from Gaia DR3 (Gaia Collaboration et al. 2022) and parameters from Zhuang et al. (2025) were used to initialize fit. For J07 we also use measurement of flux ratio  $f_2 / (f_1 + f_2) = 0.23 \pm 0.02$  by binary spectral model (Kovalev et al. 2024) for the red arm ( $\lambda = 6500 \text{ \AA}$ ) in available LAMOST

Medium Resolution spectrum (Liu et al. 2020). Unfortunately current version of SEDFit doesn't estimate uncertainties.

Resulting fits are shown in top panels of Figure 1 [Figure 1: see original paper], while lower panels are showing residuals with schematic image of the transmission function for used filters. Generally agreement is very good, though the model does worse at reproducing a small number of datapoints, including CaH, K, and W 3. Gaia XP spectrum also agrees with model for J07, however we can see slight mismatch in blue part. For J04 the best fit parameters are:  $d = 2616$  pc,  $AV = 1.47$  mag,  $R_{1,2} = 2.48, 3.62 R_{\odot}$ ,  $T_{\text{eff } 1,2} = 7600, 4463$  K,  $\log(g) = 2.00, 0.64$  cgs,  $[\text{Fe}/\text{H}] = -0.51$  dex. For J07 the best fit parameters are:  $d = 2547$  pc,  $AV = 0.03$  mag,  $R_{1,2} = 3.04, 5.18 R_{\odot}$ ,  $T_{\text{eff } 1,2} = 8061, 4276$  K,  $\log(g) = 3.50, 2.33$  cgs,  $[\text{Fe}/\text{H}] = -0.51$  dex. These estimations are similar to values from Zhuang et al. (2025), however there is difference in certain parameters, especially  $R_2$ . Additional spectroscopic observations are required to get orbits and mass ratios for J04 and J07, because currently light curve can constrain only relative size of components ( $R_{1,2}/a$  where  $a$  is a semimajor axis). Without proper orbital solution absolute sizes are based on SED fit, which is less precise.

### 3. CONCLUSIONS

I found simple explanation for anomaly 2MASS observations of two Algol-type binaries. These observations were done during the partial eclipse, phase when contribution of cool component was significantly larger than one from hot component. This Note

XP spectrum is shown for J07 as a black line.

shows that one need to carefully check photometrical data for eclipsing binaries before SED analysis, since observations during eclipses can significantly change final results.

### REFERENCES

- Allard, F., Homeier, D., & Freytag, B. 2011, in *Astronomical Society of the Pacific Conference Series*, Vol. 448, 16th Cambridge Workshop on Cool Stars, Stellar Systems, and the Sun, ed.
- C. Johns-Krull, M. K. Browning, & A. A. West, 91, doi: 10.48550/arXiv.1011.5405
- Christy, C. T., Jayasinghe, T., Stanek, K. Z., et al. 2023, *MNRAS*, 519, 5271, doi: 10.1093/mnras/stac3801
- Gaia Collaboration, Vallenari, A., Brown, A. G. A., et al. 2022, arXiv e-prints, arXiv:2208.00211. <https://arxiv.org/abs/2208.00211>
- Jayasinghe, T., Kochanek, C. S., Stanek, K. Z., et al. 2018, *MNRAS*, 477, 3145, doi: 10.1093/mnras/sty838
- Kounkel, M. 2023, *mkounkel/SEDFit: 0.3, 0.3*, Zenodo, doi: 10.5281/zenodo.8076501
- Kovalev, M., Zhou, Z., Chen, X., & Han, Z. 2024, *MNRAS*, 527,

521, doi: 10.1093/mnras/stad3222 Liu, C., Fu, J., Shi, J., et al. 2020, arXiv e-prints, arXiv:2005.07210. <https://arxiv.org/abs/2005.07210> Martin, N. F., Starkeburg, E., Yuan, Z., et al. 2024, A&A, 692, A115, doi: 10.1051/0004-6361/202347633 Skrutskie, M. F., Cutri, R. M., Stiening, R., et al. 2006, AJ, 131, 1163, doi: 10.1086/498708 Zhao, G., Zhao, Y.-H., Chu, Y.-Q., Jing, Y.-P., & Deng, L.-C. 2012, Research in Astronomy and Astrophysics, 12, 723, doi: 10.1088/1674-4527/12/7/002 Zhuang, J., Zhang, Z.-X., Gu, W.-M., & Qi, S. 2025, The Astrophysical Journal, 986, 34, doi: 10.3847/1538-4357/adcf91

*Note: Figure translations are in progress. See original paper for figures.*

*Source: ChinaXiv – Machine translation. Verify with original.*